



# Development of a Project-Based Learning (PjBL) Module for Fashion Upcycling and Zero Waste in the D3 Fashion Design Program

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**Abstract.** This study has two main objectives: (1) To describe the development stages of a Project-Based Learning (PjBL) module for Fashion Upcycling and Zero Waste, and (2) To evaluate the feasibility of this PjBL-based learning module in the D3 Fashion Design program. The research employs the Research and Development (R&D) method using the 4D development model (Define, Design, Develop, Disseminate). Data were collected through observation, documentation, interviews, and questionnaires, while quantitative descriptive analysis was used for data processing. Validation tests involved lecturers, students, and material/media experts. The results indicate that: (1) The module development process followed three main stages of the 4D model: definition, planning, development and disseminate. (2) The developed module was rated "Highly Feasible" based on expert assessments, with scores of 87.06% (material validation) and 94.4% (media validation). Thus, this module has proven effective in enhancing student participation, creativity, and understanding of sustainable concepts in fashion design. This module is expected to serve as an innovative learning resource that supports environmental sustainability-oriented vocational education.

**Keywords:** Module Development, Project-Based Learning, Fashion Upcycling, Zero Waste, Fashion Design.

## 1 Introduction

As the world becomes increasingly modern, society has grown more aware that fashion serves not only as body protection or mere style, but also as a symbol of social status. The dynamic evolution of fashion trends drives people to constantly keep up with the latest changes. This phenomenon is reflected in the rising consumption of fashion products in recent years, where individuals not only compete to wear the newest attire but also become more discerning in selecting designs that align with their personal identity. Alongside this trend, the fashion industry has introduced the concept of sustainable fashion. However, the surge in clothing trade has led to a significant increase in textile waste. In fact, the fashion industry is one of the largest contributors to global

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waste, generating 92 million tons of textile waste annually—only 12% of which is recycled ( (Bolt, 2024); (Lim, 2019); (Moreira & Felgueiras, 2025); (Muttaqin, Fatirul, & Hartono, 2019))

There are many assumptions that Indonesian society mentality is agrarian, worker, and only can be labour not a leader or activator. That assumption can be right. The fact is that work community level is dominated by the young generation who look for job vacancy, while the job opportunity which provided by the government is not match with the flow of school and university graduates.

Reveal that in fast-fashion companies, which mass-produce clothing to chase fleeting trends, waste originates from two primary sources: (1) discarded garments after trends fade, and (2) production leftovers such as fabric scraps and chemical dyes. The fast-fashion phenomenon, with its ‘produce-consume-discard’ cycle, fosters a culture of overconsumption that exacerbates environmental degradation. Every second, a truckload of textile waste ends up in landfills (Utami, Malini, & Emawati, 2023). The impact extends beyond soil and water pollution to the massive depletion of natural resources. Furthermore, textile dyeing accounts for 20% of global freshwater pollution (Vgarg, 2021), underscoring the urgent need to shift toward more sustainable fashion practices.

Amid these environmental challenges, a positive response has emerged through the growth of the sustainable fashion movement, which champions eco-friendly principles. The current waste management system in the garment industry focuses more on reduction, reuse, and recycling rather than completely eliminating waste (Fletcher & Williams, 2013). Design innovations such as upcycling the process of transforming waste into higher value products and zero-waste design, a production method that eliminates waste at the design stage, have arisen as innovative solutions to reduce the fashion industry’s ecological impact (Banning & Gam, 2018); (Lim, 2019). Notably, zero-waste pattern cutting can eliminate 15–20% of fabric waste in garment production (Banning & Gam, 2018). Recent developments indicate that upcycling practices are gaining traction among modern designers. This technique not only contributes to resource conservation but also effectively prevents textile waste accumulation in landfills. Essentially, upcycling enables the transformation of post-consumer materials into functional products without energy-intensive conventional recycling processes (Putri, 2018). Upcycling serves as a strategic marketing tool for sustainability in the fashion industry by reducing waste and engaging consumers. Its potential to foster creativity, differentiation, and brand loyalty makes it an appealing choice for fashion brands striving to align with consumer demands for ethical and sustainable practices (Ofori, Akweley, Eghan, & Acquaye, 2025).

Awareness of these benefits has prompted an increasing number of fashion brands to integrate such approaches into their operations, both as an environmental strategy and a response to growing consumer demand for sustainability (Aus, et al., 2021). Empirical evidence from educational settings demonstrates that upcycling projects can improve students’ understanding of sustainability principles by up to 88% (Banning & Gam, 2018). Nevertheless, the adoption of these sustainable techniques remains limited in vocational education curricula, particularly in developing countries like Indonesia

(Syed Azman & Bin Arsaf, 2022). This gap highlights the disconnect between theoretical awareness and practical implementation within vocational training systems.

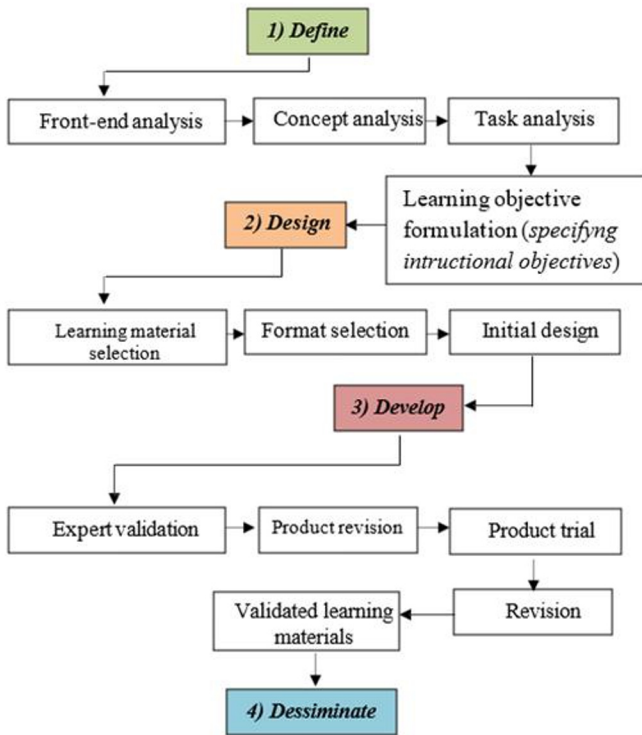
In the context of education, Fashion Design study programs play a strategic role in shaping future designers who possess not only technical competencies but also ecological awareness. However, traditional teaching methods still fail to fully utilize Project-Based Learning (PjBL) approaches, which have proven effective in developing student creativity while implementing sustainability principles (Moreira & Felgueiras, 2025); (Novianto & Masykuri, 2018)). Project-Based Learning (PjBL) serves as an active learning approach that effectively enables students to acquire new knowledge (Larmer, Mergendoller, & Boss, 2015). According to (Lenz, Wells, & Kingston, 2016), project development must incorporate both production aspects and complexity, achieved through processes involving investigation, demonstration, and application of knowledge and inspiration. PjBL creates an environment where students engage in real-world learning through collaboration, developing inquiry skills (Wiek, Xiong, Brundiers, & Leeuw, 2014), while fostering self-directed and independent learning (McGibbon & Belle, 2015). This approach proves particularly effective for teaching sustainability concepts within existing curricula (Jollands & Parthasarathy, 2013); (McGibbon & Belle, 2015)).

One critical factor determining the success of the learning process is the availability of high-quality teaching materials, where learning modules serve as essential components in facilitating in-depth understanding of subject matter. The effective use of modules can transform learners' perspectives toward scientific thinking while optimizing learning outcomes (Kuswono & Khaeroni, 2017). Therefore, the development of module-based teaching materials has become an urgent need for educators in today's information technology era. Research by Niinimäki et al. (2020) confirms that PjBL (Project-Based Learning) approaches significantly enhance both conceptual understanding and practical skills in sustainable design, including textile waste management techniques (Lim, 2019).

Building on these findings, this study aims to develop a PjBL-based "Fashion Upcycling and Zero Waste" learning module and evaluate its feasibility as instructional material for the Sustainable Upcycle & Zero Waste course. The development of this module is expected to: (1) enhance students' competency in applying upcycling and zero-waste techniques, (2) prepare competent and environmentally-conscious graduates from the D3 Fashion Design program, and (3) contribute to textile waste reduction through applied educational practices.

## 2 Method

The researchers employed the 4D development model (Define, Design, Development, and Dissemination) as it is particularly suitable for developing instructional materials rather than learning systems. This model was selected because: (1) it provides a more comprehensive and systematic framework, (2) its development process incorporates expert evaluation, ensuring that the materials undergo revision based on professional assessment, suggestions, and feedback prior to field testing.



**Fig. 1.** Modification of the 4D Model Teaching Material Development Model

The research instruments employed in this study consist of observation sheets designed to systematically evaluate and assess the module as the primary research object. The collected data serves two key purposes: (1) evaluating product feasibility and (2) guiding product refinement during the development process. For data analysis, this study utilizes descriptive analysis techniques. The research conclusions are derived through careful examination of score distributions and their corresponding percentages, which are then interpreted according to predetermined assessment categories.

**Table 1.** Percentage of Eligibility Assessment

Category	Score Percentage	Qualification	Equivalent
A (5)	81-100%	Very good	Highly eligible
B (4)	61-80%	Good	Eligible
C (3)	41-60%	Fairly good	Fairly eligible
D (2)	21-40%	Not very good	Less eligible
E (1)	0-20%	Not good	Not eligible

### **3 Result and Discussion**

#### **3.1 Result**

This development research aims to produce a valid and practical Fashion Upcycling and Zero Waste learning module. The development follows the 4D model framework (Define, Design, Develop, and Disseminate), though the study has been streamlined to focus specifically on the development phase (ending at Develop) according to research needs. The dissemination phase, which typically assesses the effectiveness of instructional materials in actual learning contexts, was not included in this study's scope.

The first phase, a comprehensive course syllabus (RPS) analysis for the Sustainable Upcycle & Zero Waste course in the D3 Fashion Design program, Department of Family Welfare Education (PKK), Faculty of Engineering (FT) at UNM, covering: (1) learning outcome identification, (2) course material determination, (3) learning activity planning, (4) assessment methods, (5) time allocation, (6) learning resources. The analysis results were then translated into specific competency achievement indicators that served as the basis for syllabus development. Concept Analysis was performed to systematically organize detailed teaching concepts. The analysis results were then translated into specific competency achievement indicators that served as the basis for syllabus development.

The second phase is the Design stage, which aims to develop the learning module. In this phase, the first step involves selecting appropriate media for the module, considering its suitability for both lecturers and students as end-users. Based on material analysis and available facilities in the D3 Fashion Design program, Department of Family Welfare Education (PKK), Faculty of Engineering (FT) at UNM, the most appropriate media was chosen for module development. The primary medium and learning resource is a student module designed by the researchers. The module design aligns with the developed learning model. Subsequently, the format was selected according to learning indicators to structure the content and learning resources. The format adheres to standards set by the PKK Department, FT UNM, particularly in syllabus (RPS) and course contract preparation. During the initial instructional design phase, researchers developed the module based on prior analysis while aligning the content with the existing syllabus. The development process of the Fashion Upcycling and Zero Waste module in the D3 Fashion Design program includes over design and module contents.



**Fig. 2.** Front and back cover view of the module

The front cover features consists of the module title, the author's name and Institutional logo. While the back cover contains an image selected to suit the contents of the module, the author's name, and Institutional logo. This module is designed with the following contents: cover page; Preface; table of contents; the contents of the module consist of 5 topics, Fundamental concepts of fashion upcycling, the History and evolution of fashion upcycling, the steps for making clothes with upcycled techniques, the basic concept of zero waste fashion, and pattern making with zero waste techniques.

The third phase focused on developing the module through a systematic process. Researchers began by compiling and analyzing various reference materials, including books, scholarly articles, academic journals, and relevant websites on fashion sustainability. To enhance the module's clarity and visual appeal, supporting images were gathered from both personal collections and online sources. Following this material collection, the research team conducted consultations with the course instructors of Sustainable Upcycle & Zero Waste to evaluate the content's appropriateness and ensure alignment with learning objectives. The developed module then underwent rigorous validation by a team of experts, encompassing both content validation (to verify subject matter accuracy) and media validation (to assess design effectiveness). Experts provided structured feedback using observation sheets that included rating scales and comment sections for both written and oral suggestions. This feedback served as the basis for iterative revisions until the module met all established standards. The quantitative results from the material experts' evaluations are presented in Table 2.

**Table 2.** Average Scores of Learning Module Quality Assessment from Subject Matter Experts

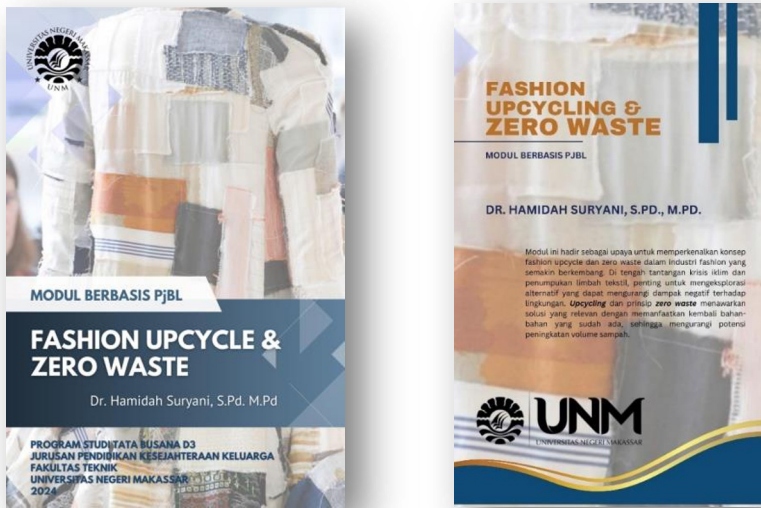
No	Aspect Evaluated	Average (%)	Category
1	Self Instructional	86.8	Very good / Highly eligible
2	Self-Contained	82.5	Very good / Highly eligible
3	Stand alone	80	Eligible
4	Adaptive	90	Very good / Highly eligible
5	User Friendly	96	Very good / Highly eligible
<b>Total Average Percentage</b>		<b>87.06</b>	<b>Very good / Highly eligible</b>

Based on the assessment scores from two material experts in Table 2, the overall average percentage was 87.06%, which falls into the 'excellent' category and is considered highly feasible. This indicates that the fashion upcycling and zero-waste module for the Sustainable Upcycle & Zero Waste course, when evaluated based on material indicators, is deemed suitable for use. The assessment results from media experts regarding the developed module can be seen in Table 3 below:

**Table 3.** Results of the Learning Module Quality Assessment from media experts

No	Assessment Aspect	Average Score	Category
1	Module Form and Size	94.9	Excellent/Highly Feasible
2	Organization	93.3	Excellent/Highly Feasible
2	Attractiveness	93	Excellent/Highly Feasible
3	Format	97.5	Excellent/Highly Feasible
4	Consistency	93.33	Excellent/Highly Feasible
<b>Overall Average Percentage</b>		<b>94.4</b>	<b>Excellent/Highly Feasible</b>

Based on the assessment scores from two media experts in Table 3, the overall average percentage is 94.4%, which falls into the 'excellent' category and is considered highly feasible. This indicates that the fashion upcycling and zero-waste module for the Sustainable Upcycle & Zero Waste course, when evaluated based on media indicators, is deemed suitable for use. After validation by material and media experts, the weaknesses of the module were identified. These weaknesses were then addressed by refining the design and product. The material experts' validation of the fashion upcycling and zero-waste module required revisions in writing style, references, and visuals (images & captions). After improvements, the module was declared ready for use in the Sustainable Upcycle & Zero Waste course. Meanwhile, the media experts' validation led to revisions in: (1) the cover page, which was revised to better reflect the characteristics of Upcycle & Zero Waste; (2) font consistency; (3) image-caption layout; (4) bibliography; and (5) the use of foreign terms. The revised front and back cover designs of the module can be seen in Figure 2 below:



**Fig. 3.** Front and back cover view of the module after revision

The fourth stage is the dissemination stage. This research is limited only to the development stage and does not proceed to the dissemination stage due to the time constraints faced by the researcher. The focus of this module's development is to test the feasibility of the fashion upcycling and zero-waste module.

### 3.2 Discussion

This study developed a learning module on Fashion Upcycling and Zero Waste for the Sustainable Upcycle & Zero Waste course in the D3 Fashion Design Program, Department of Family Welfare Education (PKK), Faculty of Engineering (FT), Universitas Negeri Makassar (UNM). The module development adapted the 4D model (Define, Design, Develop, Disseminate), with simplification up to the Develop stage. The results indicate that the module meets feasibility standards based on assessments by material and media experts.

Material experts' validation results showed an average feasibility percentage of 87.06%, classified as highly feasible, using five assessment indicators: (1) Self Instructional, (2) Self-Contained, (3) Stand alone, (4) Adaptive, and (5) User Friendly. Based on the scores from both material experts, the user friendly aspect had the highest percentage compared to other aspects, followed by adaptive, self instructional, self-contained, and stand alone. The Stand alone aspect received the lowest score due to insufficient reference sources and supporting images aligned with the module's content. However, after revisions based on the experts' feedback, the module is generally ready for use as teaching material in the Sustainable Upcycle & Zero Waste course.

Next, the media experts' validation results showed an average feasibility percentage of 94.4%, classified as highly feasible based on five assessment indicators: (1) Module form and size, (2) Organization, (3) Attractiveness, (4) Format, and (5) Consistency. From the scores given by the two media experts, the format aspect had the highest percentage compared to other aspects, followed by module form and size, consistency, organization, and attractiveness. Attractiveness received the lowest score due to the module's overly monotonous content, less realistic cover, and insufficiently engaging supporting images for each topic. However, after improvements/revisions based on the experts' feedback, the module has been proven feasible for use. Thus, the overall research findings indicate that the developed Fashion Upcycling and Zero Waste learning module is suitable as teaching material for the Sustainable Upcycle & Zero Waste course.

These findings are supported by (Bashir & Prayitno, 2024) study, which concluded that the module was rated highly feasible with high scores in presentation and language, while also helping students follow the project flow effectively. This aligns (Joyce, 2025) argument that the right combination of methods, media, and materials creates an effective and enjoyable learning experience, thereby improving student outcomes. The application of the PjBL-based learning module is further reinforced by (Zhang & Ma, 2023) research, which found that compared to traditional learning models, PjBL significantly enhances student performance and positively contributes to academic achievement, affective attitudes, and critical thinking skills—particularly academic performance. PjBL is a robust and transformative pedagogy that, when well-implemented, helps all students learn and grow (Larmer, Mergendoller, & Boss, 2015)

Additionally, Tudy highlights the benefits of PjBL in zero-waste design education, as it increases students' awareness of fabric waste generation (Gam & Banning, 2020). Integrating Fashion Upcycling and Zero Waste into the curriculum promotes sustainable practices while aligning with the course's foundational goals. This resonates with (Larmer, Mergendoller, & Boss, 2015) framework, where zero-waste design projects were developed for two courses—product development and pattern-making—using structured PjBL guidelines.

## 4 Conclusion

Based on the results of the development that has been carried out, it can be concluded that: (1) The Fashion Upcycling and Zero Waste learning module was developed for the Sustainable Upcycle & Zero Waste course in the D3 Fashion Design study program. The module development adapted the 4D model (Define, Design, Develop, Disseminate). (2) Based on the product validation results from material and media experts, the Fashion Upcycling and Zero Waste learning module was deemed suitable for use as teaching material in the Sustainable Upcycle & Zero Waste course. However, the Fashion Upcycling and Zero Waste learning module still requires further review in terms of design, content completeness, and depth. Therefore, the Fashion Upcycling and Zero Waste module needs to be further improved so that it can be used as one of the varied teaching materials in the Sustainable Upcycle & Zero Waste course.

The impact of this research on academic development is its contribution to the development of PjBL (Project-Based Learning)-based learning modules tailored to the characteristics of Fashion Design. This is important to address the challenges of learning in the digital era and the rapidly evolving fashion industry, which demands creativity and flexibility in delivering material. However, a limitation of this study lies in the limited sample size, involving only one cohort and one class level.

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